Occurrence of uniannular clefts in the living wood of *Pseudotsuga* in Portugal

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I- Introduction

Since 1957 the **internal checks** are being observed in softwoods recently cut down, concretly : *Larix decidua Mill., Thuya plicata D. Don., Chamaecyparis lawsoniana* (A.Murr.) Parl., *Abies pinsapo* Boiss., *Cryptomeria japonica* D. Don., as well as in *Pseudotsuga menziesii* (Mirb.) Franco, but always in small number and without devaluated incidences in the quality of woods whatever its prospective use (CARVALHO, 1957, 1965).

In the bibliography of the speciality, several references to this aspect can be found in these and other Conifers (LUTZ, 1952; DAY, 1950, 1954; AMOS, 1954; POLGE, 1982, 1984; MELIN, 1985; DIETRICH SON, 1985; BOULET-GERCOUT, 1986). None of the authors has attributed a relevant depreciation of the material, unless in exceptional cases (CARVALHO, 1965, 1990). Including, POLGE recognizes that the **clefts** in Douglas fir wood always appear in the earlywood and are sporadic and limited to the juvenile wood. Its definition will be related with hydric stress phenomena, eventually with internal tensions not yet clarified.

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II- Observations

The Douglas fir, introduced in Portugal in the end of the last century, although still cultivated in experimental regime, has its more representative nuclei in Estrela Mountain (Manteigas Perimeter) and in small areas in the High Portugal (Padrela-Vila Pouca de Aguiar ; Larouco-Montalegre ; Barroso-Boticas ; and Bornes). The oldest settlements take place in Manteigas and V.P.Aguiar. The seeds in the groves only come from Manteigas.

Since 1956, the development of the species in Portugal has been accompanied by a taking into account of their interesting qualities, above all in terms of volumetric production. This has to be tempered because the abundant branching spreading and the heterogenity, compromise more qualified uses.

The annual ring fissures persisted irrelevant in several observations. But, in 1988, intending to evaluate the aptitude of the wood to the peeling rotary, in material coming from Estrela Mountain (S. Lourenáo Forest), in the perspective of plywoods and packages, logs of 40-50 cm of diameter were elected then an adequated preparation (pretreatment) on orthogonal cut 0-90 was done. Surprisingly, only in 1/3 of the logs (10) was possible the total peeling rotary; in the majority it was not possible to obtain continuous veneers, by the excepcionaly high incidence of **clefts,** disturbing fact which justified the reexamination of the used material, as well as the enlargement of the sampling to regions potentially considered very interesting to the expansion of Douglas fir, concretly in other forests of Estrela Mountain (Carvalheira), in Barroso Mountain and in V.P.Aguiar, in grown up trees and in age of exploration.

Well, all the woods that come from Estrela presented always, in considerable proportion and intensity, very devaluating **annual ring radial checks** while the ones from the High Portugal, only excepcionally, in small number and circumscribed to the juvenile wood, reveled the defect simulated. Thanks to a microscopic analyse of the **clefts** characterizes in biconvex shape of radial extension limited to the annual ring, are detected in the proximity of the hole and, in the cells of the early wood, evident signs of **collapse** : walls slightly corrugated and frequent **aspirated pits**. The incidence of the defect is negatively related with the **texture** of wood and is, in many times, coincident with rays of larger cells, probably containing **resine canals.** It's not rare that the occlusion of the resinous material, defines marginal stains. In most of these situations, aren't identified structural restaurations, with **lunated buttresses**,

exceptionally observed only in the central annual rings (3-5 years), age in which also the **cleft** may surpass the exterior limit of the ring, then completely filled by parenchymatosous cells characteristic in the transition zone.

The major hole of the **clefts** rarely surpasses 1 mm, but its axial dimension is usually superior to 25 cm, often surpasses 50 cm. So the measure and the density of these **clefts** can seriously devaluate the wood, even not to allow its use in certain processings - peeling rotary. It was recognized on the other hand, to be independent of the rapidity of the formation and the predisposition to the contraction of the defect; in woods with the same width of rings (5 mm), the number of clefts may vary between 0 and 244. It is recognized that the sistematical incidence is stronger in the heartwood than in the sapwood, where it is ponctual. It can reach, in the most fissured trees, 20%; the major occurrence in the central wood can be verified between 5 and 30 years (Photos 1 to 4). Usually, the trees of less wood density are more exposed to fissuration: D12=0,419 - 258 **clefts;** D12=0,425 - 52; D12=0,489 - 13; D12=0,525 - 0. The affectation of the mechanical resistence is obviously related with the defect, as well as in axial strength as in transversal strength (See Tab. I)

The technological adverse consequences are reveled as well as in the first transformation (peeling rotary and slicing) as in the second, above all in the peripheral milling and in the operations of finishing (sanding).

III - Discussion

The conditions which determinate the formation of the **clefts** are not yet enough known. We assume that they are result of internal tensions which take place in the wood by losing control of water absorption/transpiration in critical periods of the life of the trees. The sensibility to the phenomenon is surely specific, but not irrelevant to the plant physiology and the heterogeneity of the wood structure.

Photo 1 : Transversal section of the *Pseudotsuga* trunk with numerous internal checks.

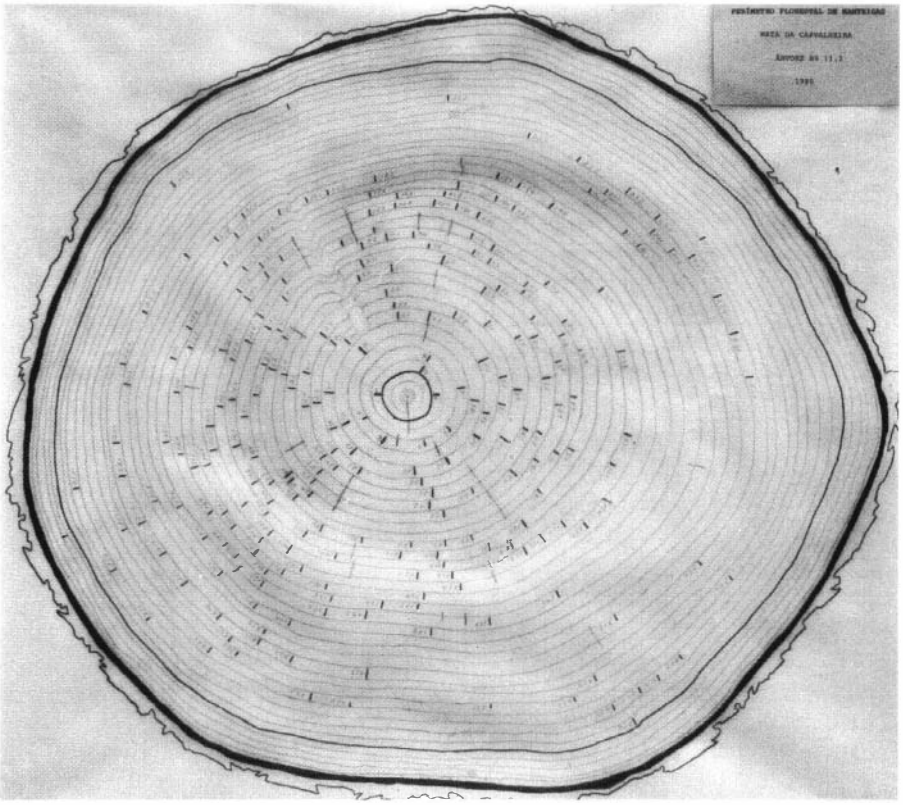

Photo 2 : Graphic representation of the same section. Distribution of the uniannular checks.

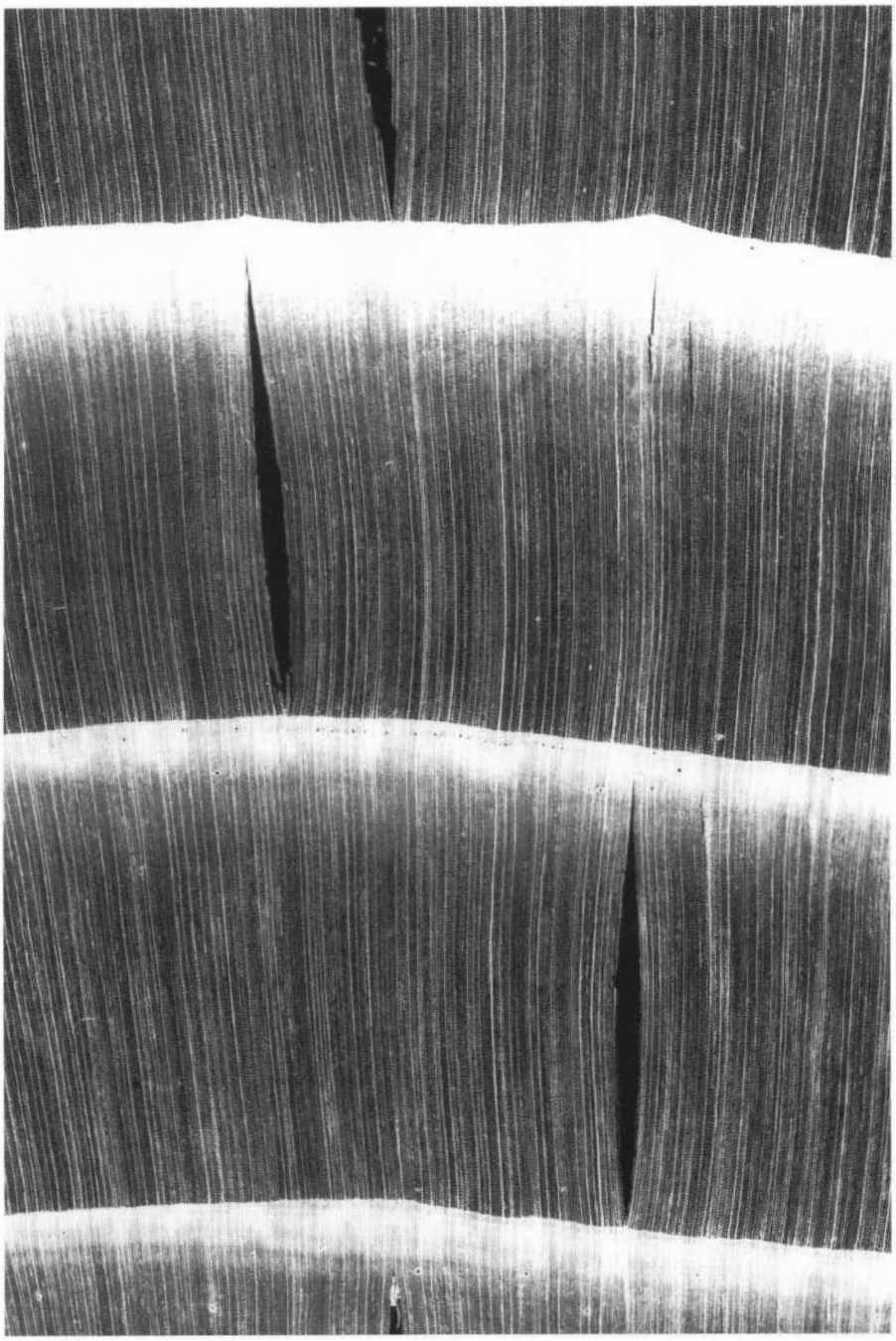

Photo 3 : Macroscopic aspect of the annual ring checks.

Tab. I Woods with D12 = 0,14 g/cm²

Number of clefts	Axial strength σ_f (kg/cm²)	σ_c (kg/cm²)	Transversal strength σ_{th} (kg/cm²)	σ_f (kg/cm²)
19	910	380	18	15
136	790	380	14	10

The major problem in forestry is to know the components of the specific sensibility of the situations of hydric stress or, in other words, the physiological debilities that abnormal or accidental conditions would reveal. They can be agressions to the root system, perturbations of certain species in the accessibility to water into the soil in particularly critical period, or when persistent deviations take place in the pluviometrical regime. This phenomena is specially deserved to the species whose stomatal regulation isn't sensible to the dryness conditions, what determines that, as Douglas fir case, the tree goes on making photosynthesis normally even with absorption deficits; These deficits go over to store water in its structural system, more sensitive in zones where the moisture content is next to the limit of the fiber saturation point, concretly, in the central portions of the trunk (heartwood). Having recourse to the reservations of the free water in these regions may lead to natural states of stress, with unavoidable phenomena of **collapse.**

We noticed that the occurrence of clefts was extremelly devaluating for the woods of the Center of the Country - Estrela Mountain, and irrelevant in the High Portugal. But in that area, in the same reforestations, different situations took place, in the decades of 1960 and 90ˢ, with unequal incidence on to clefts. As the soil conditions remained unchanged, an alarming aggravation of the minifissuring to the climatic variations could be only imputed.

However, in distinct geographical zones, and in the same cycle of wood formation, were not only recognized very different soil conditions, but, above all, very variable annual and periodical pluviosity. So, the summer-autumn pluviosity, had two particularly low periods (1960 and 1975) in Manteigas, while in V.P.Aguiar, was registered a remarkable pluviometrical persistence in the semester. But not only in this area the pluviometrical fall was higher, but, along the time, significally smaller than the semestral difference. Although it was not necessarly expectable, in this case of the fissuring direct articulation cause -

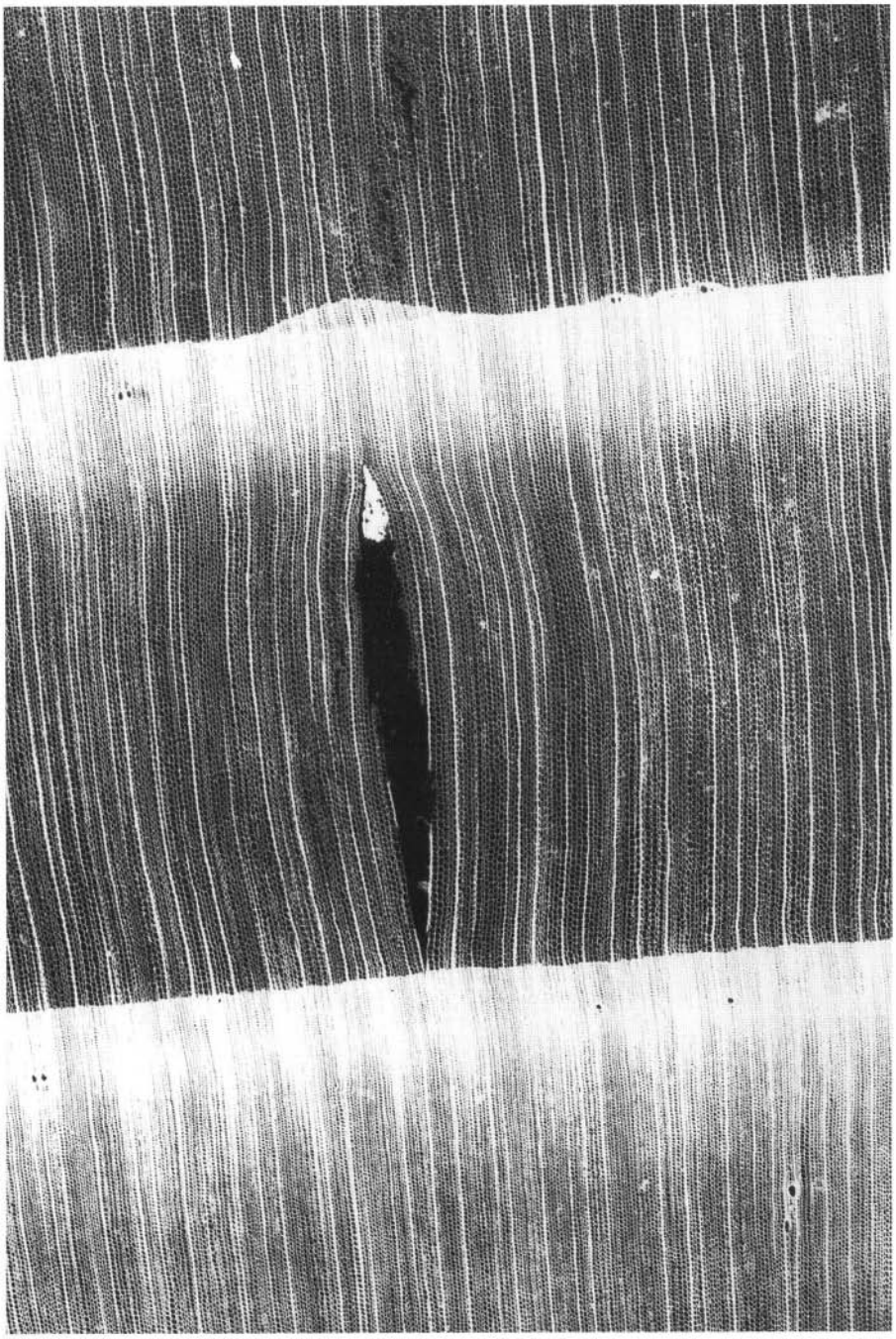

Photo 4 : Cleft with marginal lunated buttress.

effect temporally dated; We understand that logically the formation of clefts is linked to:

- structural debility due to the abnormal relation earlywood/final wood;

- hydric deficits in the soil, specially during autumn, by the perturbations which occur in the characteristic physiology of the Douglas fir, whose photosynthetic intensity is particularly high in this time of the year;

- intensification of the deficits of the pression of diffusion in the meristematic tissues, potentially determinant of internal tensions able to provoke phenomena of collapse in green wood.

We can conclude that there is a virtual climatic influence in the minifissuring, obviously not coincident, but projected into time. Besides, this would be proved in other objective situation in Carvalheira forest by two samples , respectively realized in 1960 and in 1990, in seminal material certainly from the same origine and contemporaneous development during 10 years. In trees cut down in 1960, the inci dence of the minifissuring was very small, with few checks (10-14) in the years which preceded pluviometrical minimum. On the contrary, in the trees cut down in 1990, the minifissuring grows highly, specially from 1977/78, on ciphering the clefts between 52 and 256 by complete transversal section ! We recognize, so, in the situations analysed in Carvalheira forest, that trees developped between 1930 and 1960 would only be affected by hydric crises relatively benign provoking some clefts; while that the trees developped in the second period and cut down in 1990, suffered long and disturbing summer-autumn dryness in the penultimate de cade of its growth, provoking intensive and prolonged tensions which defined a thick circular crown of 20 annual rings, in which concentrate itself about 90% of clefts present in the complete transversal sections of all observed trees.

IV - Conclusions

1. The Douglas fir, as other Conifers of quick growth in the Meridional Europe, presents a remarkable ecologycal elasticity, but a worrying structural debility, expressed by minifissuring that compromises potential utilizations of the material as solid wood.

2. The affectation doesn't revel itself in volumetrical terms, but in terms of mass and qualitative.

3. The observations realized allow consistent hypotheses of occurrence of defect in conditions of intensive hydric deficits, producing internal tensions responsible for cellular collapse and consequent hole of clefts.

4. The constatation that the minifissuring compromises irreparably the wood as solid material, emphasizes the importance of the special forestry related to the selection of provenances, reforestation and choose of areas, as well as forestry practices concerning the quality of production.

5. The hope the foresters of South Europe have built on the Douglas fir must be reconsidered by the light of this useful and convenient information.

A.C.

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Sumário

A Pseudotsuga *integra um grupo de Resinosas exóticas que podem contribuir, de maneira positiva, para superar o défice de aprovisionamento de toragem de grandes dimensiones para as industrias de madeira maciça - serragem e desenrolamento.*

Com efeito, há muitos anos que se acalenta secreta esperança de que a Espécie possa desempenhar papel meritório na arborização de zonas de montanha, onde o Pinheiro bravo tem fraco rendimento, e constitui assim um elemento preponderante na intensificação produtiva de montanha.

Entretanto, para além de um insuficiente domínio da implantação e condução dos povoamentos, bem como da prática silvotecnológica apropriada que superem as especificidades morfo-fisiológicas que contrariam, na nova floresta, a produção de madeira de qualidade (gravosos e depreciativos nós), outras singularidades são identificadas e que justificam apreensão quanto a utilizaçiones valorativas dos materiais, aconselhando prudente expansão e esclarecida predição cultural. A constatação da frequància, em povoamentos de altitude, de fendas unianelares ou minifendas definidas durante a formação, constitui em factor muito preocupante na política expansionista da essància.

A pressuposição duma eventual relação da ocorrància do defeito (muito grave) com condiçiones climáticas e singularidades fisiológicas específicas (debilidades), constitui uma informção de grande interesse e de enorme alcance para o futuro da silvicultura da Pseudotsuga,inclusive em termos de dimensão da revolução e de qualificado emprego dos materiais produzidos.

Résumé

Le Douglas intègre un groupe de résineux exotiques qui peuvent contribuer, de façon positive, à surmonter le déficit d'approvisionnement de grumes à grandes dimensions pour des industries de bois massif -sciage et déroulage

En effet, il y a déjà quelques années que l'on espère que l'espèce puisse avoir un rôle important dans le boisement aux niveaux montagnards du territoire, où le Pin maritime manque de rendement, et constituer ainsi un élément prépondérant de l'intensification productive de montagne.
Cependant, outre l'insuffisante maîtrise :

- de l'implantation et de la conduite des peuplements,

- de la pratique sylvitechnologique appropriée à l'élimination des spécificités morpho-physiologiques qui contrarient, dans la nouvelle forêt, la production de bois de qualité (exemples : nœuds)

d'autres singularités sont identifiées et justifient l'appréhension des emplois valorisants des matériaux, et conseillent une expansion prudente. La fréquence, en peuplements d'altitude, de fentes uni annelées ou micro fentes survenues pendant la formation, constitue un facteur très préoccupant dans la politique expansionniste de l'essence.

L'hypothèse d'un éventuel rapport entre le défaut (trop grave) et les conditions climatiques et singularités physiologiques spécifiques constitue une information de grand intérêt et d'une énorme portée pour le futur de la sylviculture du Douglas.

Summary

Douglas fir is one of a number of introduced coniferous species that promise to help overcome the present lack of large timber for use in the sawn-wood industry - veneer and planks.

In fact, it has been hoped for some time that Douglas fir, by playing a vital role in afforestation programmes in mountainous areas where maritime pine gives poor yields, could be the essential factor in increasing productivity in such regions.

However, there is a present inadequate understanding of :

- how best to establish and run stands of this species

- the most suitable silvicultural techniques for eliminating morpho-physiological imperfections that reduce the quality of the harvested timber (e.g. knots).

Furthermore, other factors have been identified which should lead to caution in assessing the use of the wood for sawlogs and in recommending increased use of the species. At high altitudes, splitting along the annual rings as well as tiny fissuring that occur during growth give reason to temper enthusiasm for a policy of increased use of the species.

The hypothesis that there is a relation between such serious defects and climatic conditions or the species' inherent physiological characteristics constitutes a major contribution to our understanding of the Douglas fir and to future progress in relevant silvicultural techniques.